Montana Hydrology Workshop

Helena, Montana

July 27-29, 2010

MONTANA

PRECIPITATION MAP

Sponsored by

Montana Department of Environmental Quality
Water Quality Bureau, Helena

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John Huddleston, Geophysical Computing Solutions
Kyle Flynn, Montana DEQ

HISTORY

- April 1 SWE More Than Annual Precipitation
- Runoff Equal to Annual Precipitation
- First Mountain Map by Farnes
- Mountains First 15 Year Average - 1960's
- Valleys Added 30 Year Average - Early 1970's
- Updated Early 1990's
- 30 Year Averages Updated every 10 Years
- PRISM
- Anuspline
- Mt Clim

MOUNTAINS

- SNOTEL STATIONS
- STORAGE GAGES (NRCS AND NWS)
- SNOW COURSES
  - Correlations Developed for Drainages Using Annual vs April 1 SWE at SNOTEL Sites
  - R^2 Typically Above 0.9
  - Annual Precipitation Estimated From April 1 SWE

SYNTHETIC POINTS

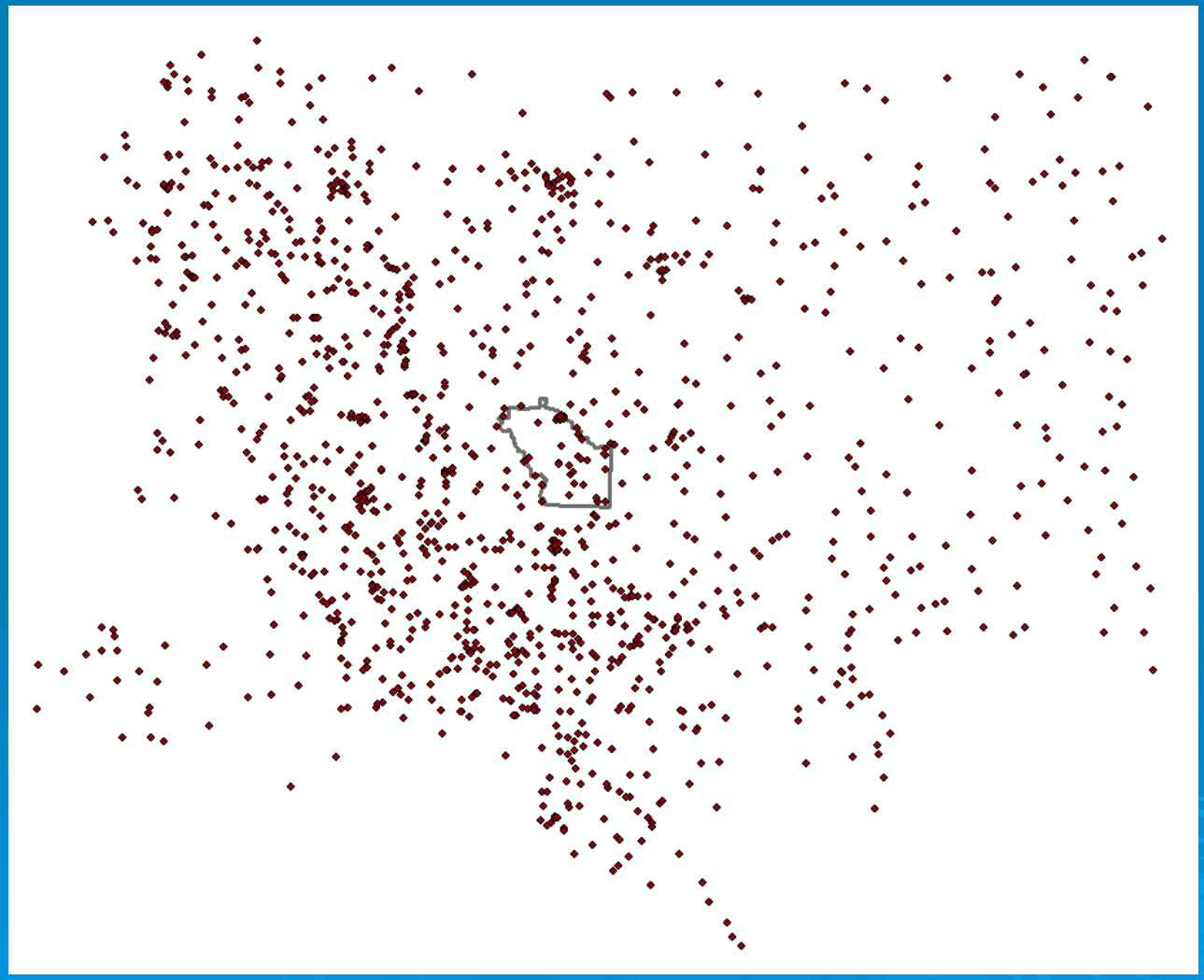
Valleys

- NWS Climatological Stations
- Estimate Average for Discontinued Stations by Correlating with Active Stations
- Estimate Average for Stations With Less Than 30 Years in Base Period
- Also Data Collected By Other Agencies and Individuals

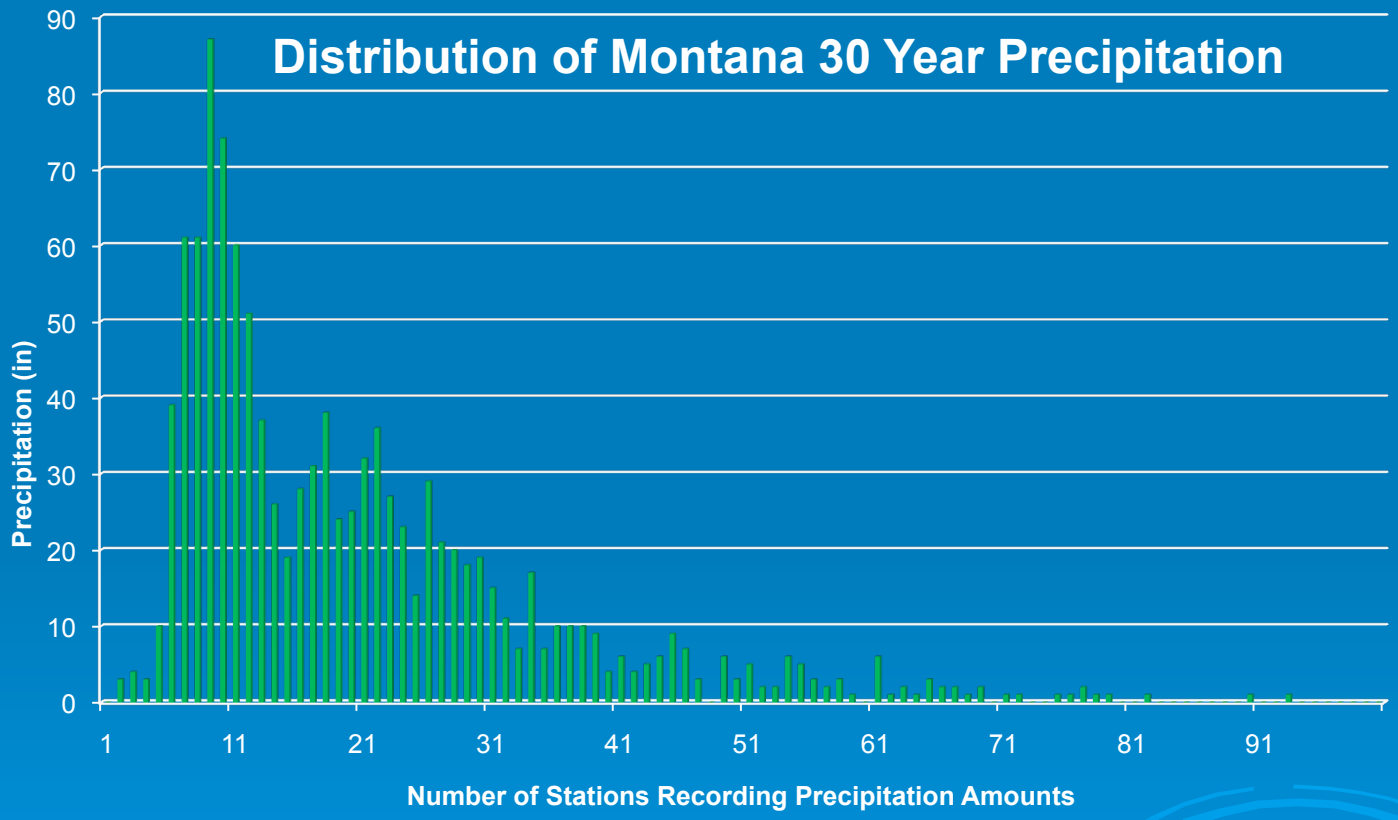
TOTAL MONTANA STATIONS

- 433 NWS Climatological Stations
- 150 NRCS SNOTEL Stations and Storage Gages
- 196 NRCS Snow Courses
- 54 NWS Storage and Hourly Gages
- 170 Synthetic Points
- 89 Idaho Snow Stations
- 122 Wyoming Stations
- 72 Canadian Station
- 14 North and South Dakota Stations

LOCATIONS



DISTRIBUTION



GIS METHODS

- **Inverse Distance Weighted**
  - No weight consideration of elevation
  - Varying power, grid size, and neighborhood
- **Multivariate Inverse Distance Weighted**
  - Weighted with precipitation
  - Weighted with quadratic precipitation
  - Weighted with linear function of elevation
  - Weighted with linear function of elevation considering east and west Montana
  - Weighted with quadratic elevation

GIS METHODS

- **Ordinary Kriging**
  - Kriging without considering elevation
- **Universal Kriging with Trend**
  - Kriging with X and Y
  - Kriging with elevation
  - Kriging with precipitation = linear elevation
  - Kriging with precipitation = quadratic elevation

GIS METHODS

Regression

Montana with Synthetic

- P = -1.62232 + 0.01810E, R^2 = .34, N=1301
- P = -2.65568 + 0.01900E, R^2 = .30, N=1068 (western)
- P = 8.25693 + 0.006412E, R^2 = .61, N=233 (eastern)
- log(P) = 1.40733 + 0.6774 log(E) R^2 = 0.2195
- log(P) = 3.09794 + 0.4082 log(E) R^2 = 0.3880
- log(P) = 1.17419 + 0.7051 log(E) R^2 = 0.3256

Montana without Synthetic

- P = 6.14179 + 0.01188E, R^2 = .24, N=1130
- P = 8.10590 + 0.01127E, R^2 = .16, N=909 (western)
- P = 8.27897 + 0.00626E, R^2 = .60, N=221 (eastern)

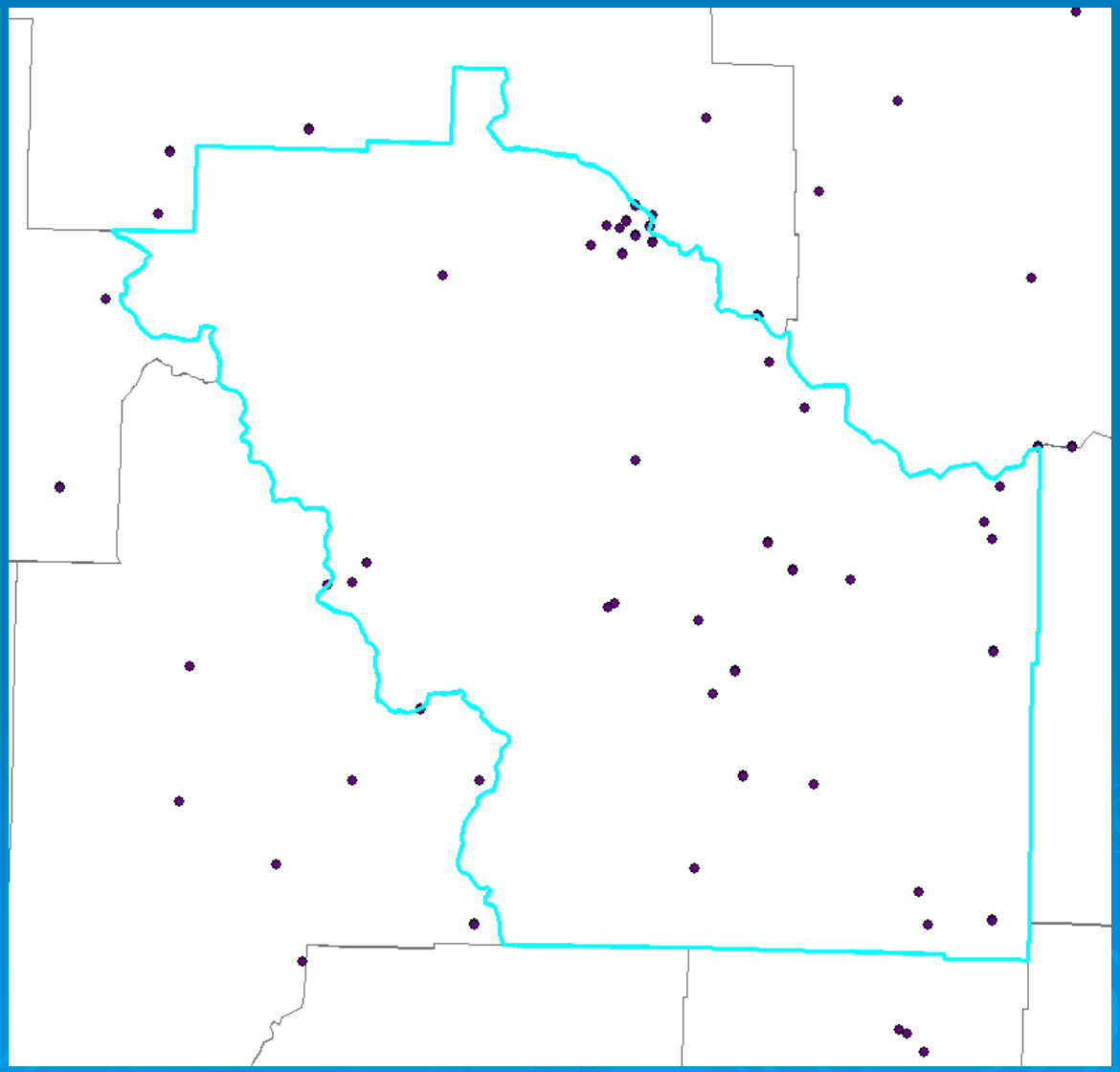
SCALE

- Montana state plane
- NED Elevation Grid 30m
- MAP analysis variable

+ ---------- 3,4
- -
- -
1,2 ---------- +

- User specifies corner (X,Y) locations
- User specifies grid size (meters)
- User specifies parameter coefficients
- User specifies neighborhood (# cells)

EXAMPLES

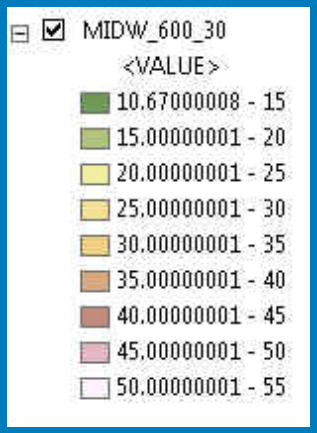


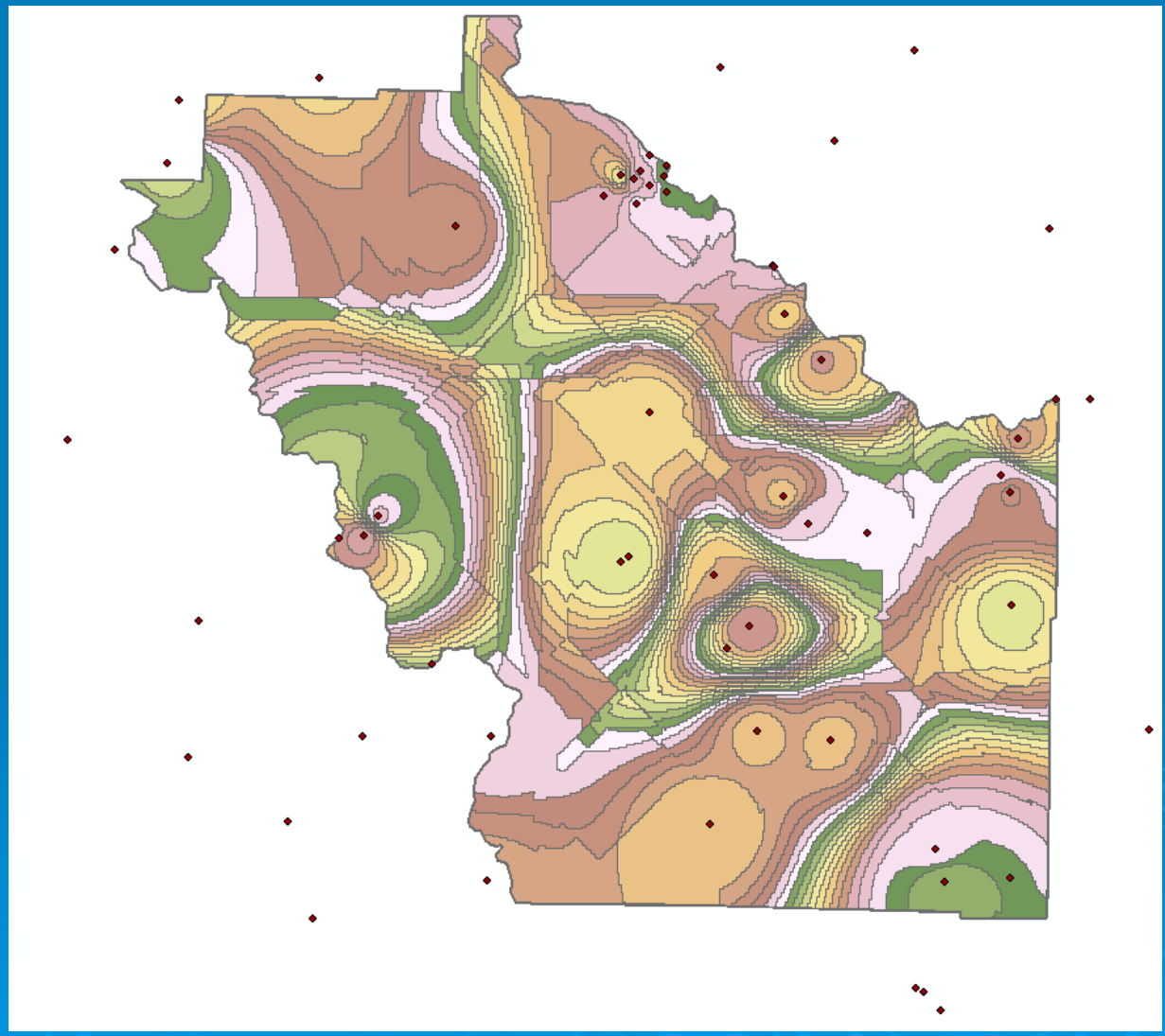
Meagher County

Precipitation Station Locations

71-00 Avg

EXAMPLES





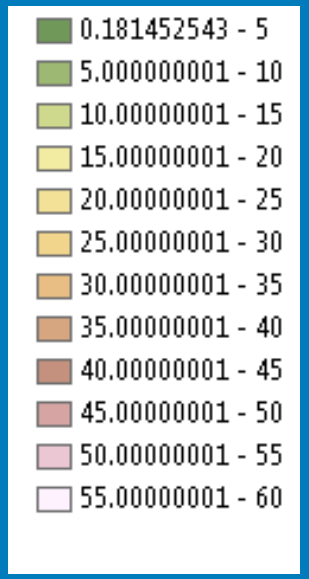
Multivariate IDW

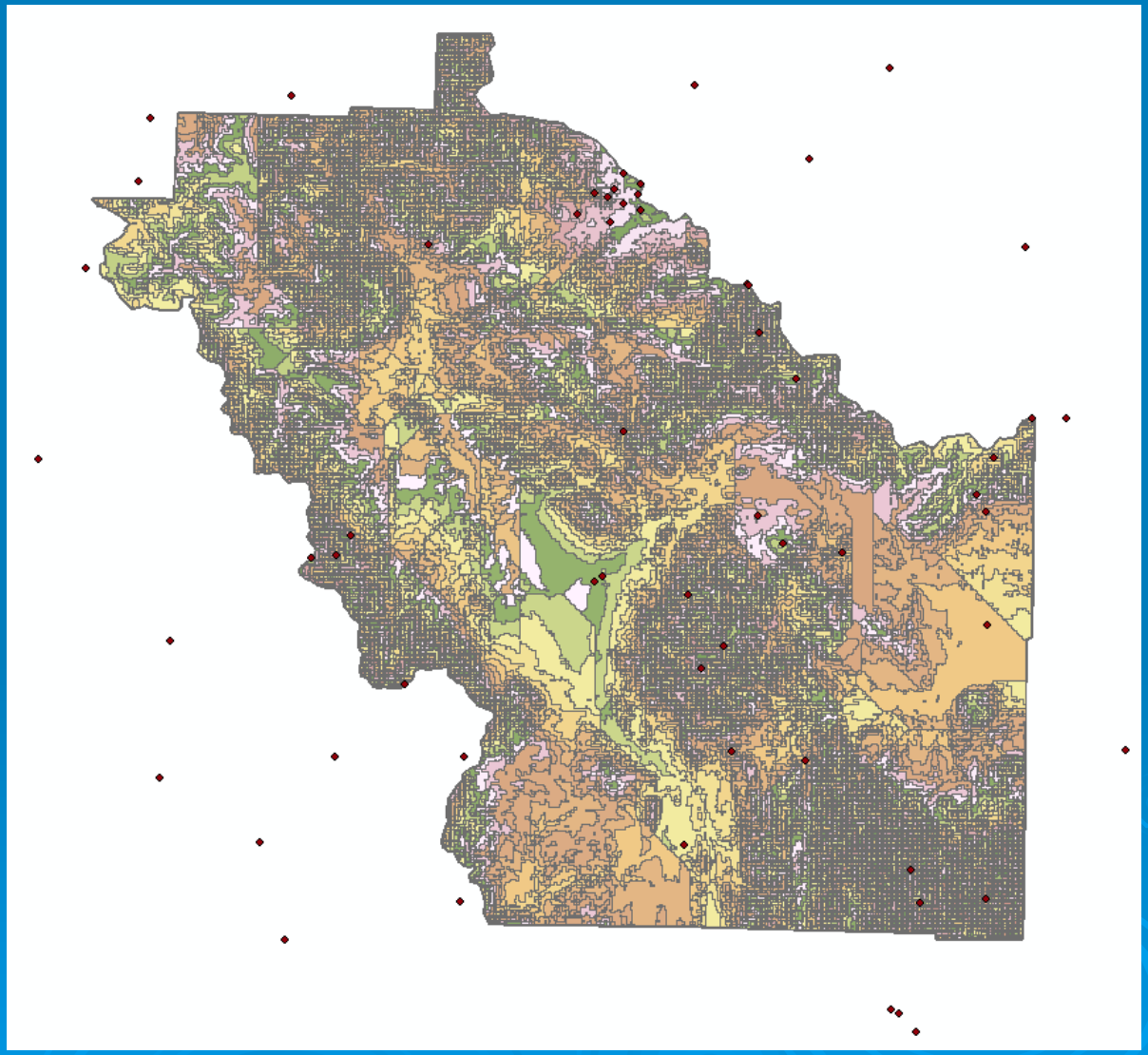
Linear

vs Farnes

hand drawn 71-00

EXAMPLES



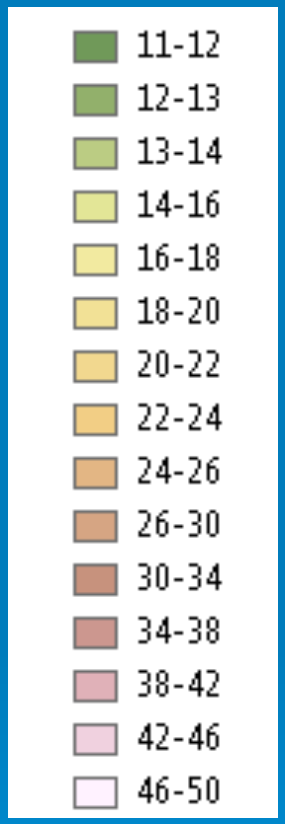


Linear Regression

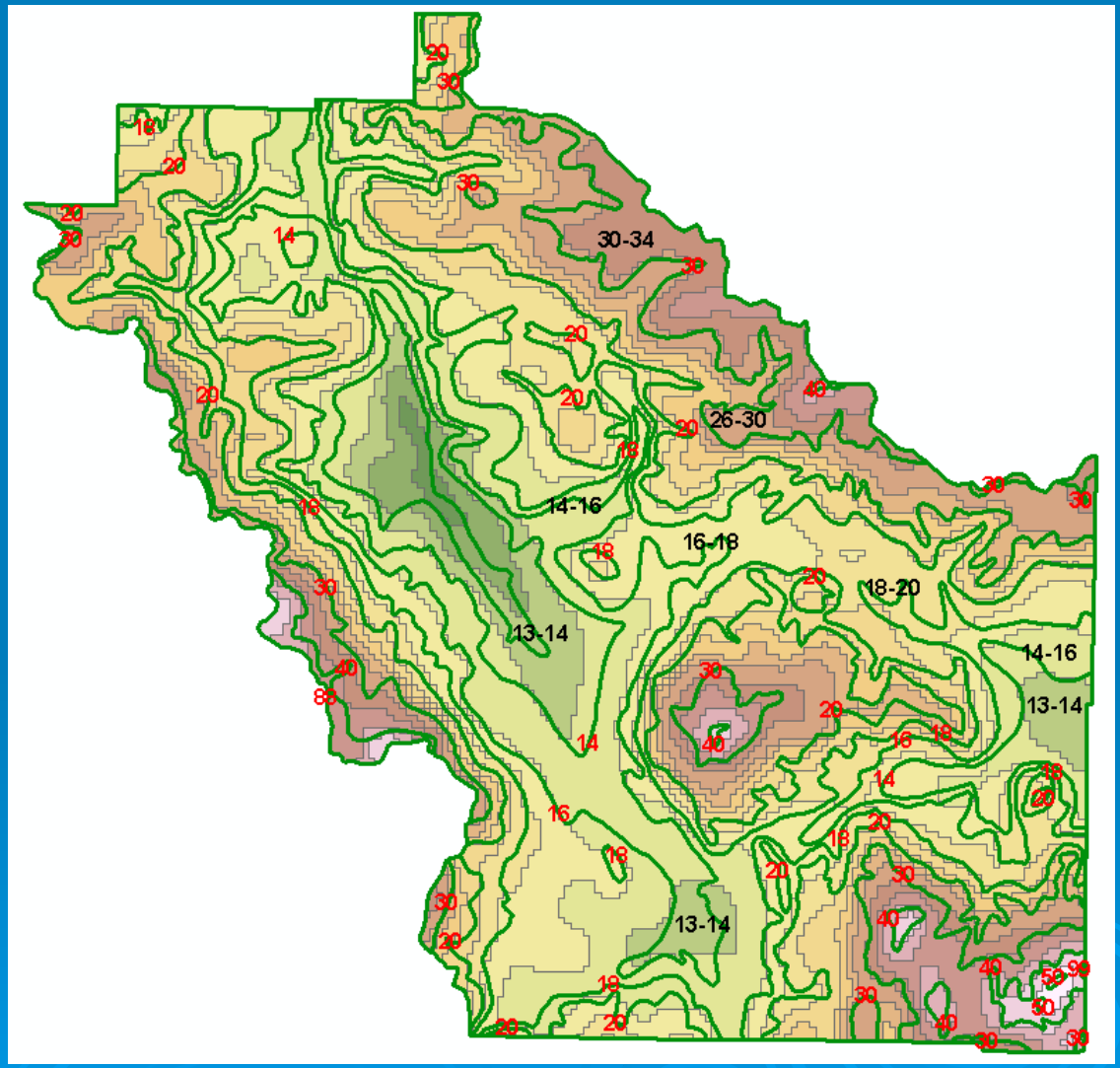
vs Farnes

hand drawn 71-00

EXAMPLES



PRISM vs Farnes hand drawn 71-00



FUTURE

- Monthly and Seasonal Precipitation
- Monthly, Seasonal, and Annual Temperatures
- Growing Degree-Days
- Day Plants Break Dormancy
- Growing Season
- Ground Snow Loads (MSU)

QUESTIONS ?